·临床研究·

# 西安社区老年人膳食结构及其与衰弱发生的相关性

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**【摘 要】 目的** 探讨西安社区老年人膳食结构及其对衰弱发生的影响。**方法** 2018年11月至2019年8月对西安某社区≥65岁的老年人进行横断面调查,根据Fried衰弱量表将其分为3组:非衰弱组、衰弱前期组和衰弱组,从各组中随机选择100人开展膳食调查。调查3组人群一般社会人口学特征,并应用膳食问卷量表调查近3 d食物种类与定量,使用因子分析确定膳食模式。采用SPSS 25.0统计软件进行数据分析。根据数据类型,分别采用秩和检验或$\chi^2$检验进行组间比较。采用多元logistic回归分析膳食模式与衰弱的相关性。**结果** 本研究共筛查1 693名老年人,其中非衰弱组724名老年人,衰弱前期组694名老年人,衰弱组275名老年人。衰弱总患病率为16.2%(275/1 693),男性与女性患病率比较(15.7%和16.6%),差异无统计学意义($P>0.05$)。通过调查确定了普通和肉豆油膳食两种模式。相比于普通膳食模式,肉豆油膳食模式摄入更多肉类、豆类和油类,且铁、维生素E、不饱和脂肪酸也明显偏高,差异均有统计学意义(均$P<0.05$)。普通膳食模式中衰弱组膳食因子得分高于非衰弱组[-0.08(-0.40, 0.36)和-0.32(-0.59, 0.06)];衰弱前期组膳食因子得分高于非衰弱组[-0.14(-0.43,0.21)和-0.32(-0.59,0.06)],差异均有统计学意义(均$P<0.05$)。在肉豆油膳食模式中,3组人群膳食因子得分差异无统计学意义($P>0.05$)。多元logistic回归分析显示,普通膳食模式得分与衰弱呈正相关,对年龄、性别、子女数量、慢病情况、手术病史、锻炼次数等因素进行校正后,结果一致。**结论** 衰弱老年人更倾向于普通膳食模式,普通膳食模式与衰弱发生风险呈正相关,老年人应加强蛋白质、脂肪和膳食纤维等营养素的摄入。

**【关键词】** 老年人; 衰弱; 膳食模式; 营养元素; 蛋白质

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# Dietary pattern and its correlation with frailty in the elderly from a community in Xi′an

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**【Abstract】 Objective** To investigate the dietary pattern and its influence on frailty in the elderly from a community in Xi′an. **Methods** From November 2018 to August 2019, a cross-sectional survey was conducted among the people aged 65 years or older dwelling in a community of Xi′an. According to the results of Fried phenotype of frailty, they were divided into three groups, that is, non-frail group, pre-frail group and frail group, with 100 people randomly selected from each group for further dietary survey. The general socio-demographic characteristics were investigated for the three groups. Dietary questionnaire and factor analysis were employed to investigate the types and quantity of food in the last 3 days and dietary patterns, respectively. SPSS statistics 25.0 was used for data analysis, rank sum test or *Chi*-square test was used for intergroup comparison based on different data types. Multivariate logistic regression analysis was used to analyze the correlation between dietary pattern and frailty. **Results** There were 1 693 elderly people subjected in this study, including 724 in the non-frail group, 694 in the pre-frail group, and 275 in the frail group. The total prevalence of frailty was 16.2% (275/1 693), but no significant difference was seen between males and females (15.7% *vs* 16.6%, $P>0.05$). Two dietary patterns, ordinary and meat-legume-oil diets, were identified through the survey. Compared with the ordinary dietary pattern, the elderly taking the meet-legume-oil dietary pattern consumed more meat, beans and oil, and significantly higher amounts of iron, vitamin E and unsaturated fatty acids ($P<0.05$). For those taking ordinary dietary pattern, the scores of dietary

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factors were obviously higher in the frail group than the non-frail group [ −0.08 (−0.40, 0.36) *vs* −0.32 (−0.59, 0.06), $P<0.05$], so as the pre-frail group and the non-frail group[ −0.14(−0.43, 0.21) *vs* −0.32(−0.59, 0.06), $P<0.05$], respectively. But for the elderly taking meet-legume-oil dietary pattern, there were no significant differences in the scores of dietary factors among the three groups ($P>0.05$). Multivariate logistic regression analysis showed that the score of ordinary dietary pattern was positively correlated with frailty, and the results were consistent after adjustment for age, gender, number of children, chronic disease, surgical history, and exercise frequency. **Conclusion** Frail elderly people are more inclined to the ordinary dietary pattern, which is positively correlated with the risk of frailty. The elderly should strengthen their intake of nutrients such as protein, fat and dietary fiber.

**【Key words】** aged; frailty; dietary pattern; nutrients; protein

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我国第七次人口普查数据显示,≥60岁的老年人口已达2.64亿,占总人口的18.7%,我国已成为世界上老年人口最多的国家。老年人常伴随痴呆、抑郁、失眠及营养不良等多种病症,而衰弱是老年人群中十分常见的严重影响生命质量的综合征。衰弱指老年人生理储备下降导致机体易损性增加,抗应激能力减退的非特异性状态,即较小刺激就可导致一系列临床负性事件的发生。其危险因素包括遗传、共病、多重用药及跌倒等,其中营养不良是一个重要危险因素。目前,营养作为一种可改变且易于控制的因素逐渐受到人们重视。有证据表明,不同的饮食结构可能在预防或减缓衰弱发作方面发挥作用。近年来有关膳食模式与健康的关系成为新的研究方向[1,2],我国尚缺乏这方面的研究。基于此,本研究对西安社区老年人进行饮食调查,构建膳食模式,探索不同膳食模式与衰弱的相关性,为制定适合我国老年人的饮食方案提供真实依据。

## 1 对象与方法

### 1.1 研究对象

2018年11月至2019年8月对西安市某社区≥65岁的老年人开展横断面调查。纳入标准:能从椅子上站起来步行6 m;意识清楚,可用言辞表达。排除标准:痴呆、精神类疾病或失明、急性感染、癌症等。共调查1 693名老年人。应用经典Fried标准筛查,并根据结果,将研究对象分为非衰弱组(non-frail group)、衰弱前期组(pre-frail group)和衰弱组(frail group)。再随机从每组中选择100名老年人,开展膳食调查。该项目得到了空军军医大学西京医院伦理审查委员会的批准,所有参与者均签署书面知情同意书。

### 1.2 方法

1.2.1 社会学特征及人体测量 采用自制人口信息表,包括性别、年龄、共病数量及手术病史等。测量身高、体质量,并计算体质量指数(body mass index, BMI)。BMI评价标准按《中国成人超重和肥胖症预防控制指南》分为4个等级:BMI<18.5 kg/m$^2$ 为消瘦,18.5~23.9 kg/m$^2$ 为正常,24.0~27.9 kg/m$^2$ 为超重,≥28.0 kg/m$^2$ 为肥胖。

1.2.2 膳食调查及分析 研究人员为入组者发放《3天24小时记录膳食调查问卷》,待填写结束后进行回收。再使用上海臻鼎健康科技有限公司研发的门诊营养咨询指导管理系统v3.0软件录入并导出数据。

1.2.3 膳食模式的确定及分析 采用降维因子分析法确定膳食模式类型。将膳食调查表记录的食品分为10类,再生成与每种膳食模式相关的10种食物组中的每一种因子负荷。较大的因子负荷值表明该食物组对特定饮食模式的贡献较大。在衍生因子中,根据碎石图结果保留2个。根据四分位数间距,将每种膳食模式的因子得分分为≤$P_{25}$,$P_{25}$~$P_{50}$,$P_{50}$~$P_{75}$,>$P_{75}$ 4个等级。

### 1.3 统计学处理

采用SPSS 25.0统计软件进行数据分析。正态分布的计量资料以均数±标准差($\bar{x}\pm s$)表示,不符合正态分布的计量资料以中位数(四分位数间距)[$M(Q_1,Q_3)$]表示,采用秩和检验。计数资料以例数(百分率)表示,组间比较采用$\chi^2$检验。采用多元logistic回归分析膳食模式与衰弱之间的关系。$P<0.05$为差异有统计学意义。

## 2 结 果

### 2.1 人群基线资料与衰弱状况

2.1.1 衰弱状况调查 本研究共筛查1693名老年人,其中男性719名,女性974名,年龄(74.56±6.29)岁。非衰弱组724名,男性占31.6%(229/724),女性占68.4%(495/724),年龄(72.1±5.14)岁;衰弱前期组694名,男性占54.3%(377/694),女性占45.7%(317/694),年龄(75.36±6.16)岁;衰弱组

275名,男性占41.1%(113/275),女性占58.9%(162/275),年龄(79.02±6.41)岁。衰弱总患病率为16.2%(275/1 693),男性患病率[15.7%(113/719)]与女性[16.6%(162/974)]比较,差异无统计学意义($P$>0.05)。

2.1.2 3组人群基线资料比较 本研究最终纳入300名进行膳食模式与衰弱的相关性研究,对每位老人进行了人体测量及调查问卷。其中16名未完成饮食调查,最终获得284名的有效数据,有效问卷回收率为94.67%。其中男性120名,女性164名,年龄(73.92±6.68)岁。3组人群年龄、子女数量、共病数量、手术病史、锻炼频率、劳累程度及过去1年内是否发生过急性事件比较,差异均有统计学意义(均$P$<0.05;表1)。

### 2.2 膳食模式与营养素

2.2.1 2种膳食模式食物种类的比较 KMO检验统计量为0.754,Bartlett's球形检验$P$<0.01,表明各食物组间存在较强相关性,适于做因子分析。特征根>1.0的因子有4个,结合碎石图及因子可解释性,最终提取2个公因子。特征根分别为3.24和1.21,方差解释率分别为25.08%和19.39%,累积方差解释率为44.48%。提取的2个公因子对应2种膳食模式,均包含主食和蔬菜,其中因子1为普通膳食模式,以水果、蛋类、鱼类、奶类和干果摄入为主;因子2为肉豆油膳食模式,以肉类、豆类和油类为主。

2.2.2 2种膳食模式营养素的比较 将最终纳入研究的284名老年人,根据膳食模式得分的四分位数,将人群由低到高分为4组,每组71名。普通膳食模式得分依次为-0.68(-0.76,-0.54),-0.35(-0.41,-0.27),0.01(-0.07,0.08)和0.52(0.33,1.05);肉豆油膳食模式得分依次为-0.76(-0.93,-0.68),-0.41(-0.49,-0.33),-0.04(-0.15,0.08)和0.81(0.51,1.52)。普通膳食模式和肉豆油膳食模式下4组人群营养素摄入量详见表2,表3。对于普通膳食模式,只有豆类蛋白在4组间的分布差异无统计学意义($P$=0.346),其余营养素组间差异均有统计学意义($P$<0.01)。所有宏量及微量营养素在肉豆油膳食模式4组间的分布,差异均有统计学意义($P$<0.001)。对2种膳食模式得分>75%组各主要营养素摄入量进行比较,发现能量、蛋白质、脂肪、碳水化合物和膳食纤维差异均无统计学意义($P$>0.05);而普通膳食模式铁、维生素E、不饱和脂肪酸和豆类蛋白的摄入明显偏低,差异有统计学意义($P$<0.05)。

### 2.3 膳食模式与衰弱的相关性

2.3.1 组间膳食因子得分的整体比较 非衰弱组、衰弱前期组、衰弱组老人的普通膳食模式得分分别为-0.32(-0.59,0.06),-0.14(-0.43,0.21)和-0.08(-0.40,0.36);肉豆油膳食模式得分分别为-0.27(-0.61,0.40),-0.25(-0.57,0.08)和-0.08(-0.50,0.66)。衰弱前期组老人普通膳食模式的因子得分高于非衰弱组($Z$=4.780,$P$=0.029),衰弱组老人普通膳食模式的因子得分也高于非衰弱组($Z$=10.900,$P$=0.001),衰弱前期组与衰弱组老人普通膳食模式的因子得分差异无统计学意义($Z$=1.314,$P$=0.252)。而对于肉豆油膳食模式,组间比较差异均无统计学意义($P$=0.105)。提示衰弱老人更倾向于普通膳食模式。

2.3.2 logistic回归分析膳食模式与衰弱的相关性 衰弱与普通膳食模式得分呈正相关(以非衰弱组为参照,衰弱前期组与衰弱组均$P$<0.05)。依次调整性别、年龄、BMI、子女数量、共病数量、手术病史、锻炼次数等因素后,衰弱前期组与普通膳食模式得分、年龄和手术史呈正相关($P$<0.05),而衰弱组与普通膳食模式得分、年龄、共病数量和手术史呈正相关($P$<0.05)。即随着衰弱程度的加重,老年人更倾向于普通膳食模式,且年龄逐渐增高,共病数量增加,有手术史的比例也升高。肉豆油膳食模式与衰弱之间未发现统计学相关性($P$>0.05)。可见,相比于非衰弱组,普通膳食模式得分越高,越倾向于衰弱,并独立于各种混杂因素的影响(表4,表5)。

## 3 讨 论

本研究首次在中国大陆探讨了老年人膳食结构与衰弱的相关性,研究发现,社区老年人普遍膳食质量不高,除主食在标准推荐范围内,其他种类的食物摄入量都偏低;衰弱老年人更倾向于普通膳食模式,而普通膳食模式的总能量、蛋白质、脂肪和膳食纤维等整体摄入偏低,尤其是铁、维生素E、多不饱和脂肪酸和豆类蛋白的摄入都明显偏低,说明衰弱老年人食用豆制品、油脂类及深海鱼等海产品严重不足。这主要是因为衰弱老人常伴有食欲不振,进食减少,造成营养不良,进而引起肌少症。研究发现,蛋白质摄入不足是老年人肌肉合成代谢障碍的主要因素,与肌肉的质量和力量均呈负相关。蛋白质来源的类型也可影响肌肉质量,动物蛋白可诱导更强的肌肉蛋白质合成和更强的身体功能[3];植物蛋白与更快的行走速度有关[4]。

**表1 3组人群基线资料比较**

Table 1 Comparison of baseline data among three groups [n(%)]

| Item | Non-frail group(n=100) | Pre-frail group(n=92) | Frail group(n=92) | $\chi^2$ | P value |
|---|---|---|---|---|---|
| Age(years) | | | | 40.691 | <0.001 |
| 65≤Age<75 | 78(78.00) | 55(59.78)* | 30(32.61)*# | | |
| Age≥75 | 22(22.00) | 37(40.21) | 62(67.39) | | |
| Gender | | | | 1.447 | 0.485 |
| Male | 47(47.00) | 36(39.13) | 37(40.22) | | |
| Female | 53(53.00) | 56(60.87) | 55(59.78) | | |
| BMI($kg/m^2$) | | | | 3.076 | 0.799 |
| BMI<18.5 | 2(2.00) | 3(3.26) | 3(3.26) | | |
| 18.5≤BMI<24.0 | 41(41.00) | 34(36.96) | 39(42.39) | | |
| 24.0≤BMI<28.0 | 45(45.00) | 37(40.22) | 35(38.04) | | |
| BMI≥28.0 | 12(12.00) | 18(19.57) | 15(16.30) | | |
| Occupation | | | | 1.739 | 0.419 |
| Mental work | 55(55.00) | 42(45.65) | 45(48.91) | | |
| Manual labor | 45(45.00) | 50(54.35) | 47(51.09) | | |
| Education | | | | 0.518 | 0.772 |
| Junior high and below | 63(63.00) | 62(67.39) | 58(63.04) | | |
| High school and above | 37(37.00) | 30(32.61) | 34(36.96) | | |
| Marital status | | | | 1.956 | 0.376 |
| Married/cohabiting | 87(87.00) | 74(80.43) | 74(80.43) | | |
| Other | 13(13.00) | 18(19.57) | 18(19.57) | | |
| Number of children | | | | 21.464 | <0.001 |
| 0-1 | 33(33.00) | 26(28.26) | 17(18.48)*# | | |
| 2 | 38(38.00) | 44(47.83) | 26(28.26) | | |
| ≥3 | 29(29.00) | 22(23.91) | 49(53.26) | | |
| Visit frequency | | | | | |
| Often | 86(86.00) | 71(77.17) | 78(84.78) | 3.01 | 0.222 |
| Other | 14(14.00) | 21(22.83) | 14(15.22) | | |
| Monthly income(yuan) | | | | | |
| <5 000 | 84(84.00) | 65(70.65) | 66(71.74) | 5.805 | 0.055 |
| ≥5 000 | 16(16.00) | 27(29.35) | 26(28.26) | | |
| Living situation | | | | 1.643 | 0.440 |
| Living alone | 12(12.00) | 13(14.13) | 17(18.48) | | |
| Living with family | 88(88.00) | 79(85.87) | 75(81.52) | | |
| Number of comorbidities | | | | 14.463 | 0.001 |
| 0-1 | 93(93.00) | 78(84.78) | 67(72.83)* | | |
| ≥2 | 7(7.00) | 14(15.22) | 25(27.17) | | |
| History of surgery | | | | 11.178 | 0.004 |
| No | 91(91.00) | 71(77.17)* | 67(72.83)* | | |
| Yes | 9(9.00) | 21(22.83) | 25(27.17) | | |
| Smoking | | | | 1.421 | 0.491 |
| No or occasional | 96(96.00) | 85(92.39) | 85(92.39) | | |
| Yes | 4(4.00) | 7(7.61) | 7(7.61) | | |
| Alcohol drinking | | | | 4.996 | 0.082 |
| No | 92(92.00) | 86(93.48) | 91(98.91) | | |
| Yes | 8(8.00) | 6(6.52) | 1(1.09) | | |
| Medication | | | | 2.891 | 0.236 |
| No | 48(48.00) | 39(42.39) | 33(35.87) | | |
| Long-term | 52(52.00) | 53(57.61) | 59(64.13) | | |
| Exercise frequency | | | | 10.977 | 0.004 |
| Not regular | 4(4.00) | 5(5.43) | 15(16.30)* | | |
| Regular | 96(96.00) | 87(94.57) | 77(83.70) | | |
| Fatigue(points) | | | | 20.646 | <0.001 |
| ≤5 | 84(84.00) | 67(72.83) | 50(54.35)*# | | |
| >5 | 16(16.00) | 25(27.17) | 42(45.65) | | |
| Character type | | | | | |
| Introvert | 9(9.00) | 13(14.13) | 16(17.39) | 5.189 | 0.268 |
| Middle | 65(65.00) | 48(52.17) | 51(55.43) | | |
| Extroversion | 26(26.00) | 31(33.70) | 25(27.17) | | |
| Acute events | | | | 7.921 | 0.019 |
| No | 97(97.00) | 87(94.57) | 80(86.96)* | | |
| Yes | 3(3.00) | 5(5.43) | 12(13.04) | | |

BMI: body mass index. Compared with non-frail group, *$P<0.05$; compared with prefrail group, #$P<0.05$.

**表 2 普通膳食模式因子得分不同等级人群的营养素摄入量比较**

Table 2 Comparison of nutrient intake of ordinary dietary pattern based on quartile scores

[$M(Q_1, Q_3)$, $n=71$]

| Nutrient | ≤$P_{25}$ | $P_{25}$–$P_{50}$ | $P_{50}$–$P_{75}$ | >$P_{75}$ | *P* value |
|---|---|---|---|---|---|
| Energy(g) | 1409.6(1000.4, 1765.7) | 1488.1(1215.3, 1697.6) | 1467.0(1130.5, 1861.9) | 1925.3(1471.2, 3046.1) | <0.001 |
| Protein(g) | 39.9(28.9, 46.6) | 44.6(35.2, 55.7) | 49.8(37.5, 61.3) | 65.5(46.6, 93.8) | <0.001 |
| Fat(g) | 25.9(16.7, 41.0) | 35.8(24.4, 46.0) | 39.1(28.8, 57.9) | 54.9(37.7, 94.7) | <0.001 |
| Carbohydrates(g) | 256.1(163.1, 323.5) | 230.4(177.5, 299.2) | 223.3(172.0, 304.8) | 286.4(230.5, 456.8) | 0.001 |
| Dietary fiber(g) | 5.7(3.7, 9.1) | 6.9(4.3, 10.6) | 8.6(5.4, 13.4) | 11.9(7.7, 20.6) | <0.001 |
| Calcium(mg) | 192.3(130.4, 272.8) | 289.5(187.1, 379.5) | 378.7(329.9, 489.3) | 524.9(399.5, 904.1) | <0.001 |
| Iron(mg) | 13.0(9.1, 16.9) | 13.7(10.6, 18.0) | 14.1(10.5, 18.7) | 18.9(12.4, 33.3) | <0.001 |
| Zinc(mg) | 6.2(4.4, 8.2) | 6.6(5.0, 8.1) | 6.6(5.4, 8.6) | 8.9(6.5, 12.3) | <0.001 |
| Selenium(μg) | 21.1(17.3, 27.0) | 24.3(18.7, 31.0) | 29.2(23.3, 37.1) | 40.3(29.0, 60.7) | <0.001 |
| Vitamin A(μg) | 129.8(57.0, 256.4) | 226.2(157.5, 300.3) | 310.3(223.7, 406.7) | 427.7(324.7, 728.2) | <0.001 |
| Vitamin E(mg) | 15.1(10.8, 24.8) | 18.8(10.6, 31.9) | 23.8(14.1, 31.5) | 30.0(18.0, 44.2) | <0.001 |
| Vitamin C(mg) | 30.3(10.9, 55.2) | 39.1(22.0, 61.1) | 49.2(30.3, 71.2) | 77.4(50.3, 109.6) | <0.001 |
| Polyunsaturated fatty acids(g) | 6.7(4.7,12.0) | 8.6(4.7,15.4) | 10.4(6.0,14.9) | 12.9(6.4,21.3) | 0.001 |
| Soy protein(g) | 0.8(0.0, 2.7) | 0.0(0.0, 1.6) | 0.0(0.0, 1.6) | 0.0(0.0, 2.1) | 0.346 |

**表 3 肉豆油膳食模式因子得分不同等级人群的营养素摄入量比较**

Table 3 Comparison of nutrient intake of meet-legume-oil dietary pattern based on quartile scores

[$M(Q_1, Q_3)$, $n=71$]

| Nutrient | ≤$P_{25}$ | $P_{25}$–$P_{50}$ | $P_{50}$–$P_{75}$ | >$P_{75}$ | *P* value |
|---|---|---|---|---|---|
| Energy(g) | 1315.5(964.6, 1680.5) | 1487.8(1103.8, 1780.8) | 1479.2(1267.7, 1816.2) | 1998.9(1550.5, 3046.1) | <0.001 |
| Protein(g) | 39.4(28.9, 50.3) | 42.5(34.9, 50.8) | 47.6(38.3, 57.5) | 70.0(50.6, 112.7) | <0.001 |
| Fat(g) | 26.5(16.7, 39.1) | 32.3(20.8, 43.1) | 38.6(32.2, 54.3) | 63.9(46.3, 93.6) | <0.001 |
| Carbohydrates(g) | 227.4(164.4, 290.4) | 238.0(159.1, 326.2) | 245.8(174.1, 310.6) | 293.4(219.4, 481.6) | <0.001 |
| Dietary fiber(g) | 4.6(3.0, 8.8) | 6.5(4.4, 10.2) | 8.2(6.1, 11.1) | 12.7(8.8, 23.3) | <0.001 |
| Calcium(mg) | 346.6(218.9, 467.1) | 303.3(169.8, 408.4) | 348.4(212.9, 477.7) | 471.4(300.2, 808.9) | <0.001 |
| Iron(mg) | 10.9(8.4, 14.1) | 13.5(10.4, 16.4) | 13.9(11.3, 17.8) | 24.7(16.9, 38.1) | <0.001 |
| Zinc(mg) | 5.9(4.4, 7.3) | 6.6(4.9, 8.3) | 6.8(5.5, 8.9) | 9.5(7.3, 14.9) | <0.001 |
| Selenium(μg) | 24.0(17.3, 28.8) | 25.2(19.3, 34.8) | 26.7(23.1, 36.2) | 43.5(29.3, 72.7) | <0.001 |
| Vitamin A(μg) | 213.6(95.9, 317.8) | 225.0(154.0, 339.4) | 297.2(184.7, 386.9) | 433.9(272.7, 641.2) | <0.001 |
| Vitamin E(mg) | 11.7(7.7, 16.9) | 17.2(12.1, 25.2) | 24.1(15.3, 32.7) | 42.2(30.9, 59.6) | <0.001 |
| Vitamin C(mg) | 27.9(17.2, 48.4) | 40.5(23.1, 58.3) | 50.0(34.0, 84.8) | 74.9(49.2, 109.1) | <0.001 |
| Polyunsaturated fatty acids(g) | 5.2(2.4,8.0) | 7.8(5.6,12.2) | 11.1(6.7,15.5) | 19.6(12.5,29.3) | <0.001 |
| Soy protein(g) | 0.0(0.0, 0.4) | 0.0(0.0, 1.1) | 0.3(0.0, 1.6) | 2.7(0.8, 7.9) | <0.001 |

**表 4 logistic 回归分析膳食模式与衰弱的相关性(模型 1)**

Table 4 Logistic regression analysis of dietary pattern and frailty (Model 1)

| Group | Assignment | *B* | *P* value | *OR* | 95%*CI* |
|---|---|---|---|---|---|
| Pre-frail | Intercept | 0.470 | 0.153 | | |
| | ≤$P_{25}$ | −1.009 | 0.019 | 0.365 | 0.157–0.845 |
| | $P_{25}$–$P_{50}$ | −0.514 | 0.247 | 0.598 | 0.250–1.428 |
| | $P_{50}$–$P_{75}$ | −0.509 | 0.239 | 0.601 | 0.258–1.402 |
| Frail | Intercept | 0.758 | 0.015 | | |
| | ≤$P_{25}$ | −1.702 | 0.000 | 0.182 | 0.076–0.435 |
| | $P_{25}$–$P_{50}$ | −0.635 | 0.134 | 0.530 | 0.231–1.217 |
| | $P_{50}$–$P_{75}$ | −1.020 | 0.018 | 0.361 | 0.155–0.840 |

Independent variables included dietary patterns based on quartile scores, as well as other potential contenders, including age (years), gender, body mass index, number of children, comorbidities, surgical history, and exercise frequency. Model 1: unadjusted.

**表5 logistic回归分析膳食模式与衰弱的相关性(模型2)**

Table 5 Logistic regression analysis of dietary pattern and frailty (Model 2)

| Group | Assignment | *B* | *P* value | *OR* | 95%*CI* |
|---|---|---|---|---|---|
| Pre-frail | Intercept | 3.116 | 0.000 | | |
| | ≤$P_{25}$ | −0.945 | 0.041 | 0.389 | 0.157−0.962 |
| | $P_{25}$−$P_{50}$ | −0.370 | 0.436 | 0.691 | 0.273−1.750 |
| | $P_{50}$−$P_{75}$ | −0.353 | 0.444 | 0.702 | 0.284−1.735 |
| | 65 years≤Age<75 years | −1.282 | 0.001 | 0.277 | 0.131−0.588 |
| | Gender(male) | −0.533 | 0.098 | 0.587 | 0.312−1.103 |
| | BMI<18.5 kg/m$^2$ | −0.035 | 0.973 | 0.966 | 0.125−7.492 |
| | 18.5 kg/m$^2$≤BMI<24.0 kg/m$^2$ | −0.570 | 0.229 | 0.566 | 0.223−1.432 |
| | 24.0 kg/m$^2$≤BMI<28.0 kg/m$^2$ | −0.334 | 0.480 | 0.716 | 0.284−1.809 |
| | Number of children(0−1) | 0.528 | 0.247 | 1.696 | 0.694−4.143 |
| | Number of children(2) | 0.745 | 0.070 | 2.107 | 0.941−4.720 |
| | Number of comorbidities(0−1) | −0.738 | 0.163 | 0.478 | 0.169−1.350 |
| | History of surgery(no) | −1.278 | 0.005 | 0.279 | 0.114−0.682 |
| | Exercise frequency(not regular) | 0.159 | 0.828 | 1.172 | 0.280−4.897 |
| Frail | Intercept | 5.190 | 0.000 | | |
| | ≤$P_{25}$ | −2.260 | 0.000 | 0.104 | 0.036−0.303 |
| | $P_{25}$−$P_{50}$ | −0.662 | 0.183 | 0.516 | 0.194−1.368 |
| | $P_{50}$−$P_{75}$ | −1.128 | 0.026 | 0.324 | 0.120−0.871 |
| | 65 years≤Age<75 years | −2.088 | 0.000 | 0.124 | 0.054−0.284 |
| | Gender(male) | −0.670 | 0.066 | 0.512 | 0.251−1.046 |
| | BMI<18.5 kg/m$^2$ | 0.365 | 0.746 | 1.441 | 0.159−13.069 |
| | 18.5 kg/m$^2$≤BMI<24.0 kg/m$^2$ | −0.151 | 0.778 | 0.860 | 0.301−2.456 |
| | 24.0 kg/m$^2$≤BMI<28.0 kg/m$^2$ | −0.099 | 0.854 | 0.905 | 0.314−2.612 |
| | Number of children(0−1) | −0.461 | 0.358 | 0.630 | 0.236−1.686 |
| | Number of children(2) | −0.477 | 0.280 | 0.621 | 0.261−1.475 |
| | Number of comorbidities(0−1) | −1.367 | 0.010 | 0.255 | 0.091−0.717 |
| | History of surgery(no) | −1.708 | 0.000 | 0.181 | 0.069−0.474 |
| | Exercise frequency(not regular) | 1.262 | 0.057 | 3.532 | 0.964−12.938 |

Independent variables included dietary patterns based on quartile scores, as well as other potential contenders, including age (years), gender, BMI, number of children, comorbidities, surgical history, and exercise frequency. Model 2: adjusted by age, gender, BMI, number of children, comorbidity, surgery history and exercise frequency. BMI: body mass index.

国外研究发现,高蛋白和高总抗氧化能力的膳食与老年妇女衰弱的低患病率密切相关[5];每日能量或蛋白质摄入增加时,衰弱发生风险会明显下降[6];前瞻性研究证实较高的蛋白质摄入[≥1.0 g/(kg·d)]能降低残疾风险[7],增加体质量和肌容积,增强握力和膝关节强度[8]。然而,美国的一项前瞻性队列研究却发现衰弱的发生风险与能量、总蛋白质和动物蛋白摄入量均无关,仅发现植物蛋白摄入量下降10 g,衰弱风险增加20%[9],提示豆类等植物蛋白在衰弱老人的饮食中显著不足。因此,衰弱指南强调[10]:老年人蛋白质摄入量应在0.8~1.5 g/kg,优质蛋白达到50%,并均衡分配到一日三餐中。此外,本研究发现衰弱老人摄入的铁、维生素E和多不饱和脂肪酸明显不足。国外研究提示缺铁引起血红蛋白下降,致衰弱的风险增加[11];低维生素A和E水平与衰弱患病率有关[12];不饱和脂肪酸ω-3对预防肌少症有益[13]。

由于食物成分间的拮抗或协同作用,膳食模式研究从宏观角度愈加受到重视,常用两种研究方法。一种是先验性膳食模式,如地中海膳食模式可显著增进健康[14],降低衰弱发生风险[15];另一种富含蔬菜、水果及全谷物的膳食模式也可减少衰弱发生的风险[16]。第二种是后验式膳食模式,即根据个人饮食摄入确定饮食模式,显然更符合实际情况。研究证实,更健康的饮食模式有助于延缓老年男性的行动障碍[17]。本研究的局限性在于样本量相对较少,膳食调查可能会受到季节的影响,存在许多未测量的混杂因素,特别是作为横断面研究,本研究的结果只能说明衰弱与特定的膳食模式存在相关性,不能说明因果关系,因此未来还需要进一步在前瞻性研究中探索证实。

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